PROJECT ELEMENTS

Effective management of construction projects requires the following elements:

* Clearly defined scope.
* Break down of work into appropriate contracts.
* Reliable cost estimates.
* Realistic schedules.
* Applicable functional requirements, performance criteria, constraints, and construction standards.
* Competent personnel.
* Efficient organization.
* Clearly designated authorities and responsibilities.
* Timely monitoring and reporting the status of work.
* Effective comparisons of progress and costs with schedules and estimates.
* Timely identification of potential or actual problems.
* Prompt action to eliminate or resolve problems.

The importance of planning in developing the preceding project elements cannot be overemphasized.

PROJECT ROLES

Responsibility for development of a project plan rests with the project manager. The role of project manager and other individuals and organizations that may participate in planning, design, and construction include the following:

The **contracting officer** is a representative of NPS who has the authority to enter into and/or administer contracts and make related decisions and findings.

The **project manager** has direct primary responsibility and accountability for management of the engineering and construction effort. He/she is designated the contracting officer's technical representative. Among the usual functions of the project manager are the following:

1) Assures costs, schedule, and scope requirements are met.

2) Acts as the principal contact between contractor and NPS.

3) Assures that instructions to the contractor are within terms of the contract.

4) Assures compliance by the contractor with technical, quality, safety, and administrative requirements of the contract.

5) Participates in formulation of plans and schedules, and recommends their approval/disapproval to the contracting officer.

6) Assures effective communication between project participants.

7) Submits requests for contract modifications to the contracting officer.

The **architect-engineer** furnishes preliminary and detailed plans and cost estimates, and sometimes validates construction engineering and contract bid cost estimates. The architect-engineer may also assist in preparation of design criteria, and perform special studies, trade-off studies, risk assessments, alternatives analysis, and estimates of contingency reserves.

The **construction contractor** usually furnishes all materials of construction, performs all construction work, and procures and installs equipment in accordance with construction drawings and specifications.

A **construction manager** provides professional management services, and functions in support of the project manager. The construction manager is generally not the same firm as the architect-engineer or construction contractor because there is a possibility of organizational conflict of interest. The decision to use a construction manager depends on size and complexity of the project, capabilities of the project management staff, and scope of the architect-engineer and construction contracts. Generally AML projects are small and straight forward, and do not require a construction manager.

TYPES OF PROJECT PLANS AND COST ESTIMATES

Six general types of plans and cost estimates are developed and used in the life of a construction project. Identification of a plan type denotes a certain level of accuracy and confidence

in the plan. These six types are defined below and in Fig. 1. The figure defines plan types by the required content, and provides guidance on the probable level of accuracy and appropriate contingency allowance. Note that the figure provides contingency guidance for both first time (green-field) and routine projects.

Order-of-Magnitude Plans and Estimates

Crude plans and estimates are developed for each project at the time of project identification. Since these are developed prior to conceptual design, they are order-of-magnitude, ballpark type plans that have the least amount of accuracy. This type of plan would result from information gathered by the AML Inventory Form, Tab VII.

Conceptual Plans and Estimates

Budget plans and estimates are required to obtain project authorization and funding appropriations. These plans and estimates are generally based on a completed **conceptual** design. Often these plans are used as baselines for justification of cost overruns. Contingency allowances should be substantial from 10 to 18% due to the lack of definitive design information. This type of plan would result from the information gathered by the AML Reconnaissance Form, Tab VII, and the preliminary cost estimate, Tab V.

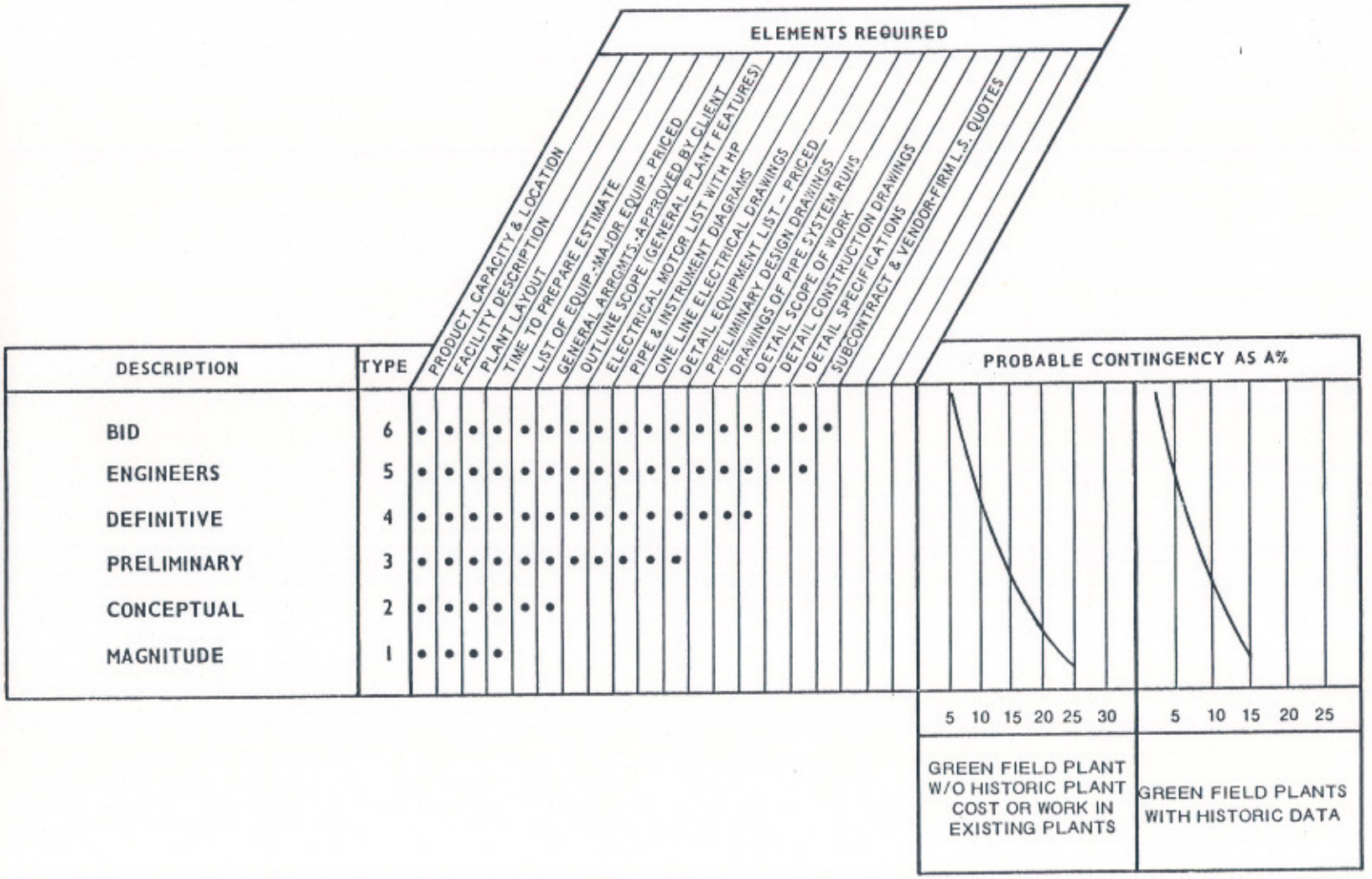
Preliminary Plans and Estimates

Preliminary plans and estimates are developed from detailed background, topographical, and subsurface data. These plans determine the requirements and criteria which govern subsequent definitive design. Tasks include preparation of preliminary engineering studies, preliminary drawings and outline specifications, life-cycle cost analysis, preliminary construction cost estimates, and scheduling for project completion. Preliminary design provides identification of long lead time procurement items and analysis of risks associated with project development. Contingency allowances generally range between 8 and 13%.

Definitive Plans and Estimates

Definitive design continues development of the project based on approved preliminary design. Definitive design includes any revisions required of the preliminary design; preparation of final working drawings, specifications, bidding documents, and cost estimates; coordination with all parties which might affect the project; development of firm construction and procurement schedules; and analysis of contract proposals and bids. Contingencies generally range from 5 to 10% of the construction cost dependent upon the extent of uncertainties remaining.

ESTIMATE TYPES



Lowell, E. D., 1975, p. 25-3

Fig. 1

Engineer's Estimate
The engineer's estimate may be made when bid design (see below) is 30, 60, and 100% complete. These estimates are usually prepared by an architect-engineer (frequently the architect-engineer who prepared the definitive design) 1) to determine the reasonableness of competitive construction bids, 2) as a control in evaluating cost and pricing data in negotiated contracts, and 3) as a check on the construction contractor. They are based on quantity take-offs and pricing of partly or fully designed portions of the project. They are probably unnecessary for small, straight forward AML projects.

Construction Bid Design and Estimate
Bid design and estimates are based on completed construction drawings, technical specifications, and competitive quotations from specialty subcontractors. The quality and completeness of the plans and specifications have a significant impact on the final price of the project.

Each plan and cost estimate should always be fully documented, and contain the plan type, reference year for the dollar figures, and date of the plan. Most importantly, the project manager must follow the NPS procurement guidance as given by Acquisition Guidelines, NPS-62.

The following table indicates the highest level of engineering generally required based on expected construction cost.

Construction Cost	Appropriate Engineering
>$10,000	Conceptual
>$100,000	Preliminary
>$250,000	Definitive
<$250,000	Bid

Exceptions to this guidance include unusual safety and health hazards, unproven or experimental technology, and any closures where the results would be uncertain without careful study and quality assurance.

The preceding six levels of planning are not all required for each project. For example, it is unnecessary to go through each of the six levels for a group of little prospect pits that have a high total closure cost but individually require nothing more than a few cubic yards of backfill and topsoil. Similarly, some parks have a large number of AML sites, and there is an opportunity to standardize designs and remediation methods. When a park provides standard designs and specifications, it is only necessary to perform conceptual design, and then final bid design and cost estimate.

SPECIAL FEATURES OF AML PROJECTS

Remediation of AML sites differ from typical construction projects in several ways.

First, there is the elimination or mitigation of public safety and health hazards associated with AML sites. Among others, the hazards include hidden shafts, abandoned explosives, bad air, and toxic substances. These hazards necessitate special training for investigators and construction workers, special construction methods, and coordination with mine rescue units. See Tabs VI and VII.

Second, there is the remediation of impacts to NPS resources. This necessitates closing the mines, constructing erosion and sedimentation control, and revegetation. Further, the remediation may constitute a major Federal action which triggers the NEPA process. See Tab II.

Third, there may be preservation of historically or culturally significant AML sites as mandated by the National Historic Preservation Act, and NPS standards and guidelines.

Fourth, management of the AML site for specific wildlife habitats may be necessary, specially for threatened and endangered species as required under the Endangered Species Act.

If you need help with the special aspects of AML sites or have any questions, phone Mining and Minerals Branch, (303) 969-2092.